

**REMARKS**

The claims have been amended in order to more particularly point out and distinctly claim the subject matter which Applicants regard as the invention. No new matter has been added. Support for the amendments to Claims 11 and 12 can be found in Figures 5 and 10 of the present specification. No new matter has been added.

Claims 2-5, 11, 12 and 15 have been rejected under 35 USC 112, second paragraph, as being indefinite for containing the language reciting "the presence of a biosludge". Although Applicants feel that Claims 11 and 12 were definite as previously presented, it is respectfully submitted that the current amendments to Claims 11 and 12 clearly make these claims comply with the requirements of 35 USC 112, second paragraph. Favorable consideration is respectfully solicited.

Claims 2-5, 11, 12, 15 and 16 have been rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over Claims 1-11 of U.S. Patent No. 6 086 766 in view of Smith et al. Claims 2, 5 and 11 have been rejected under 35 USC 103(a) as being unpatentable over Smith et al in view of JP 36-118299A. Claims 3 and 4 have been rejected under 35 USC 103(a) as being unpatentable over Smith et al in view of JP 36-118299A and further in view of JP 40-4225900A. Claim 12 has been rejected under 35 USC 103(a) as being unpatentable over Smith et al in view of JP 36-118299A and further in view of Dorau et al. Claim 15 has been rejected under 35 USC 103(a) as being unpatentable over Smith et al in view of JP 36-118299A and further in view of Lowther. Claim 16 has been rejected under 35 USC 103(a) as being unpatentable over Smith et al in view of JP 36-118299A and Dorau et al and further in view of Lowther. Applicants respectfully traverse these grounds of rejection and urge reconsideration in light of the following comments.

The presently claimed invention is directed to a process for the aerobic biological treatment of an aqueous organic waste. The process comprises the steps of introducing the aqueous organic waste into an aeration tank, aerating the aqueous organic waste in the aeration tank in the presence of a biosludge comprising aerobic microorganisms to form an aerated aqueous suspension containing excess sludge generated from the aqueous organic waste, withdrawing aerated aqueous suspension from the aeration tank and introducing the withdrawn aerated aqueous suspension into a solid/liquid separation unit, subjecting the aerated aqueous suspension in the solid/liquid separation unit to solid/liquid separation to form a separated sludge and a separated liquid phase, discharging the separated liquid phase from the process as treated water, recycling at least a portion of the separated sludge back to the aeration tank, ozonizing either a part of aerated aqueous suspension withdrawn from the aeration tank or a part of the separated sludge to ozonize and convert biosludge contained in the part of aerated aqueous suspension or part of the separated sludge into BOD components, the ozonizing taking place at a pH of 5 or lower and recycling either the ozonized part of aerated aqueous suspension or the ozonized part of the separated sludge back to the aeration tank for aerobic biological treatment, wherein the amount of biosludge ozonized and converted into BOD components is greater than the difference between the amount of biosludge generated and the amount of biosludge lost by autolysis.

A second embodiment of the present invention is also directed to a process for the aerobic biological treatment of an aqueous organic waste. This method comprises the steps of introducing the aqueous organic waste into an aeration tank, aerating the aqueous organic waste in the aeration tank in the presence of a biosludge comprising aerobic microorganisms to form an aerated aqueous suspension containing excess sludge generated from the aqueous organic waste, withdrawing aerated aqueous suspension from the aeration tank and introducing the

withdrawn aerated aqueous suspension into a membrane separation unit, subjecting the aerated aqueous suspension in the membrane separation unit to membrane separation to form a permeated liquid and a concentrated sludge, discharging the permeated liquid from the process as treated water, recycling at least a portion of the concentrated sludge back to the aeration tank, ozonizing either a part of aerated aqueous suspension withdrawn from the aeration tank or a part of the concentrated sludge to ozonize and convert biosludge containing the part of aerated aqueous suspension or part of the concentrated sludge into BOD components, the ozonizing taking place at a pH of 5 or lower and recycling either the ozonized part of aerated aqueous suspension or the ozonized part of the concentrated sludge back to the aeration tank for aerobic biological treatment, wherein the amount of biosludge ozonized and converted into BOD components is greater than the difference between the amount of biosludge generated and the amount of biosludge lost by autolysis.

As discussed previously, in the present invention an excess amount of biosludge in an aerobic biological treatment system is extracted and subjected to an ozone treatment under an acidic condition of pH 5 or lower. It is preferable that a part of the sludge to be recycled back to the aeration tank, extracted from the recycling line, is subjected to ozone treatment together with the excess sludge generated in the reaction system. Through this step, the amount of excess sludge that has to be removed and disposed of can be reduced and even completely eliminated depending on specific conditions. Through the aerobic biological treatment of the ozonized sludge suspension, organic matter containing the suspension is removed easily by biodegradation to decrease the amount of excess sludge to be discharged from the system. The larger the amount of sludge to be ozonized, the higher the rate of reduction of the sludge amount would be. In the present invention, the amount of consumption of ozone can be decreased by conducting the ozone treatment of the excess

sludge or aerated aqueous suspension at a pH of 5 or lower, to an amount of about 1/2 to 1/3 of the amount used at a higher pH.

In the aerobic biological treatment system according to the present invention illustrated in Figure 1, an amount of biosludge 3a is maintained in the system in order to have a steady state aerobic biotreatment of the introduced organic waste. 3b is newly grown biosludge formed by the treatment of the incoming organic waste. 3c is an autolysis decrement which occurs from subjecting the biosludge 3a to autolysis and the reaction. As such, in a steady state of operation, the difference between newly grown biosludge 3b and autolysis decrement 3c is the multiplication increment 3d. Further loss of biosludge occurs from the withdrawn biosludge 3f for ozone treatment and biosludge 3g is generated due to the BOD portion formed by ozone-decomposition and biosludge is also discharged from the system as 7.

The amount of biosludge in the treatment system increases due to microbial multiplication by anabolysis in the system by the amount of 3d resulting from the addition of biosludge amounts  $3b + 3g$  - the outgoing biosludge amounts  $3c + 3f$  and is held in balance with the exhausted amount 7. The prior art references cited by the Examiner fail to disclose how to attain a decrease in the over-all biosludge growth amount 3d down to below 50%, since biological digestion treatment of excess biosludge will result in "digested sludge" which is impervious to biological attack.

The present invention attains a decrease in the generated biosludge amount 3d down to below 50% and even to 0% by the process required in the present claims including conducting the ozonization at a pH of 5 or lower. That is, by effecting the ozone treatment of the excess sludge at a pH of no greater than 5, the amount of ozone required is about from 1/2 to 1/3 of the amount required in the prior art techniques without pH control. It is respectfully submitted that the prior art cited by the Examiner does not disclose the present invention.

U.S. Patent No. 6 086 766 has been cited as the primary reference in an "obviousness-type" double patenting rejection. In this type of a rejection, only the claims are used as "prior art". Since only Claim 2 requires that the ozone treatment be performed at a pH of 5 or lower, the currently pending claims are distinguished from Claims 1 and 3-8 of U.S. Patent No. 6 086 766 by the lack of the disclosure of the claimed pH requirement. Additionally, the claims of this reference have no disclosure with respect to the amount of biosludge being ozonized and converted into BOD components being greater than the difference between the amount of biosludge generated and the amount of biosludge lost by autolysis. As discussed above, the process of the present claims enables an aerobic biological treatment system to be operated such that the amount of generated excess sludge formed in the entire system can be reduced to 0. It is respectfully submitted that the prior art cited by the Examiner does not disclose the presently claimed invention.

The Smith reference has been combined with U.S. Patent No. 6 086 766 in the "obviousness-type" double patenting rejection. This reference discloses the treatment of sewage and/or other biodegradable waste materials in its system comprising an aerobic process wherein a settleable sludge is formed and comprises returning a part or all of the sludge to a point in advance of the input of the aerobic process and subjecting a selected portion of the return sludge to microbial biolysis by means such as electrolysis, ultrasonics, heat, low temperature, photochemistry and ozonization. The portion of the returned sludge is selected to meet the food requirements of the active aerobic bacteria in the aerobic process. The portion subjected to biolysis is regulated such that substantially all of the biodegradable matter is consumed and only a relatively small quantity of sludge is removed to end disposal. This reference has no disclosure with respect to reducing the over-all multiplication of the biosludge in the entire treatment system down to below 50% to even 0% by

employing the ozonization step of the biosludge as required by the present claims.

Smith discloses, in column 1, lines 59-67, that process control problems are due to the necessity of producing a constant process efficiency from the numerous variables present in the inflow, such as volume, strength, etc. The inventory of biological population must be necessary to be sufficient for maximum loading conditions when these conditions occur. On the other hand, for the balance of the time, an "underloaded condition" exists which adversely affects process values, efficiency and control.

The system in the Smith reference works on the basis of artificially maintaining a correct ratio of food to organisms as a steady state condition. The protozoa readily assimilate the dead bacterial masses resulting from the biolysis and by means of their oxidative metabolic processes continuously convert the food to carbon dioxide and water. To achieve this end, this reference provides a microbial biolysis unit consisting of a source of radiant energy in which a controlled portion of the sludge, after biolysis, is returned to the system. This means that in the Smith method, controlled biolysis of the excess sludge is effected in the "underloaded condition" and excess sludge forming condition in order to control the ratio between these portions so as to maintain a predetermined balance between the biodegradable organic matter, which constitutes food for the process, and the active organisms in the aerobic treatment step such that the inactivated organisms returned to the treatment step after biolysis are substantially consumed by the active organisms with a corresponding reduction in sludge content. Biolysis of the excess sludge is stopped in the "overloaded condition" because further biolysis of the excess sludge would cause an irregular balance between the biodegradable organic matter and the active organisms. Therefore, in the method disclosed in Smith, controlled biolysis of excess sludge is performed only

in the "underloaded condition" and the biolysis is performed on the excess sludge which has already been generated.

Applicants also wish to point out that the Smith reference has no disclosure with respect to the advantages of ozonizing the biosludge at a pH of not greater than 5. Therefore, the secondary references cited by the Examiner must provide the motivation to one of ordinary skill in the art to modify the Smith reference in a manner such that the claimed method is obtained. It is respectfully submitted that the secondary references cited by the Examiner contain no such motivation.

JP 36-118299A discloses a method for modifying and dehydrating organic sludge in which the pH of sludge supplied from a sludge tank is adjusted to from 3-6 and then mixed and contacted with an ozone-containing gas to perform modification thereof. The modified sludge is dehydrated and discharged as a dehydrated cake. However, this reference has no disclosure with respect to performing a process for biological treatment of aqueous organic waste using an ozonization step in which the amount of biosludge ozonized and converted into BOD components is greater than the amount of excess sludge generated or the advantages associated with the ozonization step taking place at a pH no greater than 5.

Furthermore, while the Examiner points out that JP '299 teaches an ozone-treatment of waste at a pH of 3-6, the ozone-treatment taught by JP '299 is directed to a process for dewatering or modification of an organic biosludge for the purpose of obtaining a hygienic dewatered cake of biosludge of a low moisture content. It is stated in the portion from line 10 of the right upper column to line 10 of the left lower column on page 2 of JP '299, that "it is known that ozone exhibits functions of sterilization, deodorization and anti-tasting and has been used, for example, for treating drinking water and waste water and for deodorization of sewage water", suggesting that the purpose of the JP '299 invention is clearly different from that of the present invention.

Further, there is a description in JP '299, lines 7 to 20 in the right lower column on page 2, that "free radical of ozone will attack the double bond of a molecule of a high polymer to result in degradation of the polymer molecule to destroy a gelled substance, binder layer or cell membrane, whereby removal of intracellular water is made easy". Thus, JP '299 is silent as to the reduction of excess sludge formation in an aerobic biological treatment of waste water down to a level of 50% or lower.

Therefore, it is respectfully submitted that the presently claimed invention is patentably distinguishable over Smith et al in combination with JP 36-0118299A.

JP 40-4225900A discloses a method for anaerobically digesting organic sludge in which an organic sludge is heated in a sludge heating tank, introduced into a flotation concentration tank and then introduced into an anaerobic digestion tank. However, this reference does not cure the deficiencies of the previously discussed references in that it does not disclose the performing of an ozonization step in which the amount of biosludge ozonized and converted into BOD components is greater than the amount of excess sludge generated or the advantages associated with the ozonization step taking place at a pH no greater than 5 or suggest anything regarding the benefits achieved by such an operation. As such, it is respectfully submitted that the presently claimed invention is patentably distinguishable over this reference in combination with any of the previously discussed references.

The Dorau et al reference discloses a method and apparatus for biologically purifying sewage which is organically loaded with substances which are difficult to decompose biologically or not decomposable biologically. This reference further discloses the use of membrane-filtering or nano-filtering to remove substances that are difficult to decompose biologically or not biologically decomposable. However, this reference does not cure the deficiencies of the

previously discussed references in that it does not suggest operating a process for biological treatment of aqueous organic waste utilizing an ozonization step in which the amount of biosludge ozonized and converted into BOD components is greater than the amount of excess sludge generated or the advantages associated with the ozonization step taking place at a pH no greater than 5. As such, the presently claimed invention is patentably distinguishable over this reference in combination with any of the previously discussed references.

The Lowther reference discloses a process for the intermediate treatment of aqueous sewage containing biodegradable materials and non-biodegradable materials. The sewage is contacted with an organic-containing gas to pretreat the sewage by converting a substantial amount of the non-biodegradable material to biodegradable material, followed by a conventional secondary treatment with an oxygen-containing gas such as air in the presence of aerobic or facultative anaerobic microorganisms. This process may also include subsequent tertiary treatment with ozone to destroy the microorganisms after secondary treatment. However, this reference does not disclose the performing of an ozonization step under such conditions such that the amount of biosludge ozonized and converted into BOD components is greater than the amount of generated excess sludge or the advantages associated with the ozonization step taking place at a pH no greater than 5. Therefore, Applicants respectfully submit that the currently claimed invention is patentably distinguishable over this reference in combination with any of the previously discussed references.

None of the references cited by the Examiner disclose performing an ozonization step in which the amount of biosludge ozonized and converted into BOD components is greater than the amount of generated excess sludge or the advantages associated with the ozonization step taking place at a pH no greater than 5. As stated previously, in the present invention, the amount of excess sludge which has to be

removed and disposed of can be eliminated by ozonizing and converting to BOD components an amount of biosludge which is greater than the amount of excess sludge generated and an unexpected high efficiency is achieved by conducting the ozonization at a pH no greater than 5. None of the references cited by the Examiner disclose these features and, as such, it is respectfully submitted that the presently claimed invention is patentable over the prior art cited by the Examiner.

Reconsideration of the present application and the passing of it to issue is respectfully solicited.

Respectfully submitted,

  
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